

C L A I M S

1. A wander generator comprising:

random number generating means for sequentially
generating a random number signal comprised of a
5 plurality of bits at a constant rate in accordance with
a predetermined algorithm;

a filter unit for receiving a sequence of random
number signals output from said random number
generating means for performing filtering;

10 clock generating means for generating a clock
signal;

modulating means for modulating the frequency of
the clock signal generated by said clock signal
generator by a signal output from said filter unit; and

15 setting means for setting each amplitude value for
a spectrum of a signal sequence output from said filter
unit such that the characteristic of wander of the
clock signal having the frequency modulated by said
modulating means matches a desired characteristic.

20 2. A wander generator according to claim 1,
characterized in that said random signal generating
means has a plurality of pseudo random signal generator,
wherein said plurality of pseudo random signal
generators combine pseudo random signals generated
25 thereby respectively, and is configured to sequentially
generate random number signals comprised of the
plurality of bits at a constant speed.

3. A wander generator according to claim 1,
characterized in that said filter unit includes a
plurality of storage elements for storing an input
signal sequence while sequentially shifting it; and
5 calculating means for performing a product sum
calculation of stored values stored in said plurality
of storage elements with a plurality of coefficients.

4. A wander generator according to claim 3,
characterized in that said filter unit is configured to
10 store a random number signal sequence output from said
random number generating means in said plurality of
storage elements, perform the product sum calculation
by means of said calculating means, and filter the
random number signal sequence,

15 said setting means sets the plurality of
coefficients in said calculating means as signals for
setting respective amplitude values for spectra of the
signal sequence output from said filter unit.

5. A wander generator according to claim 3,
20 characterized in that said filter unit comprises:

data distributing means for distributing the
random number signal sequence generated by said random
number signal generating means into a plurality of
paths having different rates from each other;

25 weighting means for weighting a signal sequence
for each of the paths distributed by said data
distributing means with a previously set coefficient

for each of the paths; and

combining means for combining the signal sequences on the respective paths weighted by said weighting means by means of a plurality of sub-band combiners
5 comprised of a plurality of storage elements and calculating means and for outputting the result of the combination as the result of filtering, and

said setting means sets the plurality of weighting coefficients in said weighting means of said filter
10 unit as signals for setting respective amplitude values for spectra of the signal sequence output from said filter unit.

6. A wander generator according to claim 3 or 5, characterized by further comprising initial setting
15 means for initially setting values equivalent to stored values stored in said respective storage elements in a steady state in which the clock signal having the wander of the desired characteristic is being output to said respective storage elements included in the filter
20 unit at least in an initial phase of operation of said apparatus through a path different from a signal input path in the steady state.

7. A wander generator according to claim 1, characterized by further comprising:

25 characteristic calculating means for calculating a characteristic of wander in a clock signal frequency-modulated by said modulating means based on information

including a signal set in said filter unit from said setting unit; and

characteristic display means for displaying the characteristic calculated by said characteristic calculating means.

8. A digital line tester comprising:

a wander generator unit for generating a test signal having wander; and

a wander measuring unit for evaluating a signal passing through a digital line under testing from said wander generator unit,

characterized in that:

said wander generator unit includes the wander generator according to any of claims 1 through 7; and

said tester is configured to output a test signal synchronized with a clock signal output from said wander generator.

9. A wander generator for generating a clock signal having wander which satisfies a desired time deviation characteristic, characterized by comprising:

center frequency information setting means for setting data for determining a center frequency of the clock signal;

characteristic information setting means for setting characteristic information of the desired time deviation characteristic;

a fluctuating signal sequence generator unit for

generating a fluctuating signal sequence having a power spectrum density distribution characteristic of frequency fluctuations corresponding to the desired time deviation characteristic based on characteristic information set by said characteristic information setting means;

an adder for adding data set by said center frequency information setting means to the fluctuating signal sequence output from said fluctuating signal sequence generator unit;

a direct digital synthesizer for outputting a frequency signal corresponding to an output of said adder; and

a clock signal output circuit for waveform shaping an output signal of said direct digital synthesizer to output a clock signal.

10. A wander generator according to claim 9, characterized in that said fluctuating signal sequence generator unit comprises:

noise generating means for generating a white noise signal based on a pseudo random signal;

impulse response processing means for calculating an impulse response of a transfer function for approximating a power spectrum of a white noise signal output from said noise generating means to a power spectrum density distribution characteristic of the frequency fluctuations based on the characteristic

information set by said characteristic information setting means; and

convolution processing means for convoluting the result of the calculation by said impulse response processing means with the missourians white noise signal output from the noise generating means to generate a fluctuating signal sequence having the power spectrum density distribution characteristic of the frequency fluctuations.

11. A wander generator according to the claim 10, characterized in that said impulse response processing means corrects an impulse response with a correction function corresponding to an error between the power spectrum density distribution characteristic of the frequency fluctuations and the transfer function.

12. A wander generator according to claim 10, characterized in that said convolution processing means preferentially performs the product sum calculation for smaller absolute values of the result of the calculation for the impulse response.

13. A wander generator according to claim 10, characterized in that said impulse response processing means is configured to perform the calculation for the impulse response each time a white noise signal is output from the noise generating means; and

said convolution processing means performs the convolution processing using the result of the

calculation made each time by the impulse response processing means.

14. A wander generator according to claim 9, characterized in that said fluctuating signal sequence generator unit comprises:

noise generating means for generating a white noise signal based on a pseudo random signal;

data distributing means for distributing noise signals output from said noise generating means into signal paths respectively in accordance with a plurality of bands into which a frequency range of a power spectrum density distribution characteristic of the frequency fluctuations is divided to output at rates corresponding to the respective bands;

weighting means for applying weights in accordance with the magnitude of spectrum of each of the bands into which the frequency band of the power spectrum density distribution characteristic is divided for the noise signals at the respective rates distributed by said data distributing means; and

combining means for combining the noise signals at the respective rates weighted by said weighting means to generate a fluctuating signal sequence having the power spectrum density distribution characteristic of the frequency fluctuations.

15. A wander generator according to claim 10 or 14, characterized in that said noise generating means has a

plurality (m) of sets of pseudo random signal
 generating means for generating pseudo random codes of
 M sequence at initial phases different from one another,
 and is configured to collect outputs at predetermined
 5 stages of said respective pseudo random signal
 generating means to output an m-bit parallel white
 noise signal.

16. A digital line tester comprising:

a wander generator for generating a clock signal
 10 having wander which satisfies a defined time deviation
 characteristic;

a transmission unit for sending a digital signal
 synchronized with the clock signal output from said
 wander generator to a digital line under testing;

15 a reception unit for receiving the digital signal
 returned from said digital line under testing and
 restoring a clock signal of the received digital
 signal;

an error measuring unit for measuring errors in
 20 the digital signal received by said reception unit;

a time deviation measuring unit for measuring a
 time deviation characteristic of the clock signal
 restored by said reception unit;

a display device; and

25 display control means for displaying the result of
 measurements of said error measuring unit and the time
 deviation characteristic measured by said time

deviation measuring unit on said display unit in such a manner that it can be compared with the defined time deviation characteristic.

17. A digital line tester according to claim 16,
5 characterized in that said wander generator is the wander generator according to any of claims 9 through 15.

18. A digital line tester comprising:

white noise generating means for generating a
10 digital white noise signal;

a filter unit having a digital signal for storing
a digital signal in a plurality of internal storage
elements while sequentially shifting therein and
performing product sum calculations for the contents
15 stored in said plurality of storage element for
converting a noise signal output from said white noise
generating means to a noise signal of a frequency
characteristic corresponding to a previously set
characteristic coefficient to output the noise signal;

20 characteristic coefficient setting means (130) for
setting arbitrary characteristic coefficient in said
filter unit;

a multiplier for multiplying a noise signal output
from said filter unit by an amplitude coefficient;

25 amplitude setting means for setting an arbitrary
coefficient to the multiplier;

a frequency synthesizer for outputting a clock

signal which is phase modulated by a noise signal
output from said multiplier; and

initial setting means for initially setting a
noise signal sequence equivalent to the contents stored
5 in the respective storage elements of said digital
filter in a state in which a noise signal of a
frequency characteristic corresponding to the
characteristic coefficient is being output from said
filter unit in the respective storage elements of said
10 digital filter at least in an initial phase of
operation of said apparatus.

19. A digital line tester comprising:

white noise generating means for generating a
digital white noise signal;

15 a filter unit having a digital signal for storing
a digital signal in a plurality of internal storage
elements while sequentially shifting thereinto and
performing product sum calculations for the contents
stored in said plurality of storage element for
20 converting a noise signal output from said white noise
generating means to a noise signal of a frequency
characteristic corresponding to a previously set
characteristic coefficient to output the noise signal;

characteristic coefficient setting means for
25 setting arbitrary characteristic coefficient in the
filter unit;

a multiplier for multiplying a noise signal output

from said filter unit by an amplitude coefficient;

amplitude setting means for setting an arbitrary coefficient to said multiplier;

5 a frequency synthesizer for outputting a clock signal which is phase modulated by a noise signal output from said multiplier;

characteristic calculating means for calculating a characteristic of a noise signal output from said multiplier or a clock signal output from said frequency synthesizer based on a characteristic coefficient set by said characteristic coefficient setting means and an amplitude coefficient set by said amplitude setting means; and

10 characteristic display means for displaying the characteristic calculated by said characteristic calculating means.

20. A phase noise transfer characteristic analyzer comprising:

characteristic specifying means for specifying an arbitrary phase noise characteristic;

parameter calculating means for calculating a parameter required to generate a test signal of a phase noise characteristic specified by said characteristic specifying means;

25 test signal generating means for generating a test signal having the phase noise characteristic based on a parameter calculated by said parameter calculating

means;

first phase noise characteristic measuring means
for measuring a phase noise characteristic of the test
signal generated by said test signal generating means;

5 an output terminal for outputting the test signal
generated by said test signal generating means to an
external device under analysis;

an input terminal for inputting a signal output
from the device under analysis which has received the
10 test signal;

second phase noise characteristic measuring means
for measuring a phase noise characteristic of a signal
input from said input terminal in parallel with the
measurement of the phase noise characteristic for the
15 test signal by said first phase noise characteristic
measuring means;

approximation error calculating means for
calculating a difference between the phase noise
characteristic specified by said characteristic
20 specifying means and the phase noise characteristic
measured by said first phase noise characteristic
measuring means as an approximation error; and

virtual characteristic calculating means for
correcting the phase noise characteristic measured by
25 said second phase noise characteristic measuring means
with the approximation error calculated by said
approximation error calculating means to calculate a

virtual phase noise characteristic of a signal which is
output when assuming that the device under analysis has
received a test signal of the phase noise
characteristic specified by said characteristic
specifying means,

characterized by making it possible to know the
difference between the phase noise characteristic
specified by said characteristic specifying means and
the virtual phase noise characteristic calculated by
said virtual characteristic calculating means.

21. A phase noise transfer characteristic analyzer
comprising:

characteristic specifying means for specifying an
arbitrary phase noise characteristic;

parameter calculating means for calculating a
parameter required to generate a test signal of a phase
noise characteristic specified by said characteristic
specifying means;

test signal generating means for generating a test
signal having the phase noise characteristic based on a
parameter calculated by said parameter calculating
means;

phase noise characteristic calculating means for
calculating a phase noise characteristic of the test
signal generated by said test signal generating means;

an output terminal for outputting the test signal
generated by said test signal generating means to an

external device under analysis;

an input terminal for inputting a signal output from the device under analysis which has received the test signal;

5 phase noise characteristic measuring means for measuring a phase noise characteristic of a signal input from said input terminal;

approximation error calculating means for calculating a difference between the phase noise
10 characteristic specified by said characteristic specifying means and the phase noise characteristic measured by said phase noise characteristic measuring means as an approximation error; and

virtual characteristic calculating means for
15 calculating a virtual phase noise characteristic of a signal output when assuming that the device under analysis has received a test signal of the phase noise characteristic specified by said characteristic specifying means,

20 characterized by making it possible to know the difference between the phase noise characteristic specified by said characteristic specifying means and the virtual phase noise characteristic calculated by said virtual characteristic calculating means.